

Claims

1. A wind farm with at least two wind turbines (1, 2, 3, 4) connected to a power grid, further comprising
5 a control unit (5) connected to said at least two wind turbines (1, 2, 3, 4), and
10 a sensor unit (6) connected to said power grid and said centralized control unit (5),
15 wherein said sensor unit (6) is adapted to measure the grid frequency of said power grid and to transmit said measured grid frequency to said control unit (5), and
wherein said control unit (5) is adapted to control the output of real power of said wind farm according to said measured grid frequency.
- 20 2. The wind farm according to claim 1, wherein said sensor unit (6) is a separate substation or integrated into one of said at least two wind turbines (1, 2, 3, 4).
- 25 3. The wind farm according to claim 1 or 2, wherein said control unit (6) is adapted to shut down individual wind turbines within the wind farm.
4. The wind farm according to any of the preceding claims, wherein centralized control unit (6) is adapted to gradually and/or continuously reduce the power output of individual wind turbines within the wind
30 farm.
5. The wind farm according to any of the preceding claims, wherein said control unit (6) further comprises a selection unit for selecting individual wind turbines (1, 2, 3, 4) within said wind farm.
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6. The wind farm according to any of the preceding claims, wherein said sensor unit (6) is adapted to transmit said measured grid frequency to said control unit (5) by radio, optical, sound or electrical signal means.

7. A wind farm with at least two wind turbines (1, 2, 3, 4) connected to a power grid, further comprising
- 5 a coupling device (7) for coupling the wind farm to the power grid, and
- a sensor element (8) for sensing a first variable representative of said wind farm
- 10 wherein said sensor element (8) is adapted to transmit said measured first variable to said coupling device (7), and
- wherein said coupling device (7) is adapted to control a second variable of said wind farm according to said measured first variable.
- 15 8. The wind farm according to claim 7, wherein said sensor element (8) is integrated into said coupling device (7).
9. The wind farm according to claim 7 or 8, wherein said first variable is the actual power output of the wind farm, the actual output current of
- 20 the wind farm or the actual voltage at the point of coupling to the power grid.
10. The wind farm according to any of claims 7 to 9, wherein said second variable is the total current output of the wind farm.
- 25 11. The wind farm according to any of claims 7 to 10, wherein the coupling device comprises semiconductor switching devices for controlling the power output of said wind farm.
- 30 12. The wind farm according to any of claims 7 to 11, further comprising the features of any of claims 1 to 6.
13. A method for operating a wind farm according to any of claims 1 to 6, said method comprising the steps of:
- 35 measuring the grid frequency with a sensor unit,
- transmitting said measured grid frequency to a control unit,

determining whether the measured grid frequency lies outside a predetermined range, and

5 if the measured grid frequency lies outside said predetermined range, selecting at least one out of the at least two wind turbines comprised in said wind farm by said control unit and regulating the power output of said selected at least one wind turbine.

10 14. A method for operating a wind farm according to any of claims 7 to 12, comprising the steps of:

measuring a first variable representative of said wind farm by said sensor element,

15 transmitting said measured first variable to a coupling device,

determining whether the measured first variable lies outside a predetermined range, and

20 if the measured first variable lies outside the predetermined range, selecting at least one out of the at least two wind turbines comprised in said wind farm by said coupling device and regulating the power output of said selected at least one wind turbine by controlling a second variable of said wind farm.

25 15. The method according to claim 14, wherein said second variable is the current output of said selected at least one wind turbine or the actual voltage at the point of coupling to the grid.

30 16. The method according to any of claims 13 to 15, wherein the criteria for selecting the at least one wind turbine are life time and/or maintenance considerations and/or operating or load conditions of an individual wind turbine.

35 17. The method according to any of claims 13 to 16, wherein the selected at least one wind turbine is shut down or started.

18. The method according to any of claims 13 to 16, wherein the controlled variable, especially power output, current output or voltage at the point

of coupling to the grid, of said selected at least one wind turbine is reduced or increased gradually.

5 19. The method according to any of claims 13 to 16, wherein the controlled variable, especially power output, current output or voltage at the point of coupling to the grid, of said selected at least one wind turbine is reduced or increased continuously.

10 20. A procedure for operating a wind farm, comprising the steps of:
operating the wind farm at its maximum total power output while the grid frequency stays within a predetermined range, and

15 reducing the power output according to a method of any of claims 13 to 19 when the grid frequency exceeds the upper boundary value of said range.

20 21. A procedure for operating a wind farm, comprising the steps of:
operating the wind farm at a predetermined power output below the maximum power output of said wind farm while the grid frequency remains within a predetermined range,
25 reducing the power output according to a method of any of claims 13 to 19 when the grid frequency exceeds the upper boundary value of said range, and

30 increasing the power output according to a method of any of claims 13 to 19 when the grid frequency undershoots the lower boundary value of said range.

AMENDED CLAIMS

[received by the International Bureau on 22 September 2004 (22.09.2004);
original claim 1-21 replaced by amended claims 1-18]

1. A wind farm with at least two wind turbines (1, 2, 3, 4) connected to a
5 power grid, further comprising

a coupling device (7) for coupling the wind farm to the power grid,

a sensor element (8) for sensing a first variable representative of said
10 wind farm, wherein said sensor element (8) is adapted to transmit said
measured first variable to said coupling device (7),

a control unit (5) connected to said at least two wind turbines (1, 2, 3,
4), and
15 a sensor unit (6) connected to said power grid and said centralized
control unit (5), wherein said sensor unit (6) is adapted to measure the
grid frequency of said power grid and to transmit said measured grid
frequency to said control unit (5), and
20 wherein said coupling device (7) is adapted to control a second variable
of said wind farm according to said measured first variable, and

wherein said control unit (5) is adapted to control the output of real
25 power of said wind farm according to said measured grid frequency,
and

2. The wind farm according to claim 1, wherein said sensor unit (6) is a
30 separate substation or integrated into one of said at least two wind
turbines (1, 2, 3, 4).

3. The wind farm according to claim 1 or 2, wherein said control unit (6)
is adapted to shut down individual wind turbines within the wind farm.

35 4. The wind farm according to any of the preceding claims, wherein
centralized control unit (6) is adapted to gradually and/or continuously
reduce the power output of individual wind turbines within the wind
farm.

5. The wind farm according to any of the preceding claims, wherein said control unit (6) further comprises a selection unit for selecting individual wind turbines (1, 2, 3, 4) within said wind farm.
- 5 6. The wind farm according to any of the preceding claims, wherein said sensor unit (6) is adapted to transmit said measured grid frequency to said control unit (5) by radio, optical, sound or electrical signal means.
7. The wind farm according to any of the preceding claims, wherein said
10 sensor element (8) is integrated into said coupling device (7).
8. The wind farm according to any of the preceding claims, wherein said
15 first variable is the actual power output of the wind farm, the actual output current of the wind farm or the actual voltage at the point of coupling to the power grid.
9. The wind farm according to any of the preceding claims, wherein said second variable is the total current output of the wind farm.
- 20 10. The wind farm according to any of the preceding claims, wherein the coupling device comprises semiconductor switching devices for controlling the power output of said wind farm.
- 25 11. A method for operating a wind farm according to any of claims 1 to 10, said method comprising the steps of:

measuring a first variable representative of said wind farm by said sensor element,

30 measuring the grid frequency with a sensor unit,

transmitting said measured first variable to a coupling device,

transmitting said measured grid frequency to a control unit,

35 determining whether the measured first variable lies outside a predetermined range, and, if the measured first variable lies outside the predetermined range, selecting at least one out of the at least two wind turbines comprised in said wind farm by said coupling device and

regulating the power output of said selected at least one wind turbine by controlling a second variable of said wind farm, and

5 determining whether the measured grid frequency lies outside a predetermined range, and, if the measured grid frequency lies outside said predetermined range, selecting at least one out of the at least two wind turbines comprised in said wind farm by said control unit and regulating the power output of said selected at least one wind turbine.

10 12. The method according to claim 11, wherein said second variable is the current output of said selected at least one wind turbine or the actual voltage at the point of coupling to the grid.

15 13. The method according of claim 11 or 12, wherein the criteria for selecting the at least one wind turbine are life time and/or maintenance considerations and/or operating or load conditions of an individual wind turbine.

20 14. The method according to any of claims 11 to 13, wherein the selected at least one wind turbine is shut down or started.

25 15. The method according to any of claims 11 to 13, wherein the controlled variable, especially power output, current output or voltage at the point of coupling to the grid, of said selected at least one wind turbine is reduced or increased gradually.

30 16. The method according to any of claims 11 to 13, wherein the controlled variable, especially power output, current output or voltage at the point of coupling to the grid, of said selected at least one wind turbine is reduced or increased continuously.

17. A procedure for operating a wind farm, comprising the steps of:

35 operating the wind farm at its maximum total power output while the grid frequency stays within a predetermined range, and

reducing the power output according to a method of any of claims 11 to 16 when the grid frequency exceeds the upper boundary value of said range.

18. A procedure for operating a wind farm, comprising the steps of:

5 operating the wind farm at a predetermined power output below the maximum power output of said wind farm while the grid frequency remains within a predetermined range,

10 reducing the power output according to a method of any of claims 11 to 16 when the grid frequency exceeds the upper boundary value of said range, and

15 increasing the power output according to a method of any of claims 11 to 16 when the grid frequency undershoots the lower boundary value of said range.